

**Geologic Resources Inventory Workshop Summary
Bryce Canyon National Park, Utah
*July 13-14, 1999***

**National Park Service
Geologic Resources Division
and
*Natural Resources Information Division***

Version: Draft of August 10, 1999

EXECUTIVE SUMMARY

An inventory workshop was held at Bryce Canyon National Park on July 13-14, 1999 to view and discuss the park's geologic resources, to address the status of geologic mapping by both the Utah Geological Survey (UGS) and the United States Geological Survey (USGS) for compiling both paper and digital maps, and to assess resource management issues and needs. Cooperators from the NPS Geologic Resources Division (GRD), Natural Resources Information Division (NRID), Bryce Canyon NP and Natural History Association, UGS, USGS, University of Arizona and Waterworks Consultants, were present for the two-day workshop. ([See Appendix A, Bryce Canyon NP Geological Resources Inventory Workshop Participants, July 13-14, 1999](#))

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Day one involved a field trip co-led by University of Arizona geology professor George Davis and USGS geologist Pete Rowley.

Highlights of the field trip can be found at
http://www.nature.nps.gov/grd/geology/gri/ut/brca/field_trip_brca

Day two involved a scoping session to present overviews of the NPS Inventory and Monitoring (I&M) program, the Geologic Resources Division, and the ongoing Geologic Resources Inventory (GRI) for Colorado and Utah. Round table discussions involving geologic issues for Bryce Canyon NP included interpretation, the UGA Millennium 2000 guidebook featuring the geology of Utah's National and State parks, the status of cooperative geologic mapping efforts, sources of available data, geologic hazards, potential future research topics, and action items generated from this meeting. Brief summaries of each follow.

OVERVIEW OF GEOLOGIC RESOURCES INVENTORY

After introductions by the participants, Steve Fryer (NPS-NRID) presented an overview of the NPS I&M Program, the status of the natural resource inventories, and the geological resources inventory ([see Appendix B, Overview of Geologic Resources Inventory](#)).

He also presented a demonstration of some of the main features of the **digital geologic map** for the Black Canyon of the Gunnison NM and Curecanti NRA areas in Colorado. This has become the prototype for the NPS digital geologic map model as it ideally reproduces all aspects of a paper map (i.e. it incorporates the map notes, cross sections, legend etc.) with the added benefit of being a GIS component. It is displayed in ESRI ArcView shape files and features a built-in help file system to identify the map units. It can also display scanned JPG or GIF images of the geologic cross sections supplied with the map. The cross section lines (ex. A-A') are subsequently digitized as a shape file and are hyperlinked to the scanned images.

For a recap on this process, go to: http://www.nature.nps.gov/grd/geology/gri/blca_cure/
and view the various files in the directory.

The geologists at the workshop familiar with GIS methods were quite impressed with this method of displaying geologic maps digitally; Joe Gregson is to be commended for his accomplishments.

Bruce Heise (NPS-GRD) followed with an overview of the Geologic Resources Division and the Geologic Resources Inventory and the main goals summarized below:

1. to assemble a bibliography of associated geological resources for NPS units with significant natural resources,

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2. to compile and evaluate a list of existing geologic maps for each unit,
 3. to develop digital geologic map products, and
 4. to complete a geological report that synthesizes much of the existing geologic knowledge about each park. The emphasis of the inventory is not to routinely initiate new geologic mapping projects, but to aggregate existing information and identify where serious geologic data needs and issues exist in the National Park System.
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INTERPRETATION

The GRI also aims to help promote geologic resource interpretation within the parks and GRD has staff and technology to assist in preparation of useful materials including developing site bulletins and resource management proposal (RMP) statements appropriate to promoting geology. Jim Wood (GRD) and Melanie Moreno (USGS-Menlo Park, CA) have worked with several other NPS units in developing web-based geology interpretation themes, and should be considered as a source of assistance should the park desire.

The UGS has the Geologic Extension Services available for help to the NPS for creating interpretive brochures and for seasonal employee training. The UGS also has programs for applied geology (hazards), economic geology, archeology and paleontology. Pete Rowley and George Davis have generously offered their services and are also available for any assistance the park may need regarding geologic issues and interpretation.

Doug Neighbor presented the most asked question of interpreters at Bryce Canyon as follows:

- Q: Why aren't there any fossils in the Claron Formation?
A: Oxidized environment didn't promote fossil preservation; soil pedogenesis churned and obliterated any life forms
- Q: Is the Claron freshwater or marine?
A: Freshwater; marine seas had retreated in late Cretaceous

From these questions, the major interpretive struggle at BRCA is trying to present a modern analogue for the Claron depositional setting. Because the Claron is so well exposed here, it certainly makes for a great place to attempt to answer these questions.

Doug also mentioned that Jan Stock (Chief of Interpretation) and Rob Danno (Chief Ranger) are relative newcomers to the park (June 1999) and weren't able to make the field trip or scoping session.

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Bryce Canyon Natural History Association

Gayle Pollock mentioned that the Bryce Canyon Natural History Association (NHA) is currently developing an extended web page for <http://www/nps.gov/brca> with a "GeoDetective" theme aimed at 2nd-4th graders. It was suggested that perhaps Jim Wood (GRD), Melanie Moreno (USGS), or Sandy Eldredge (UGS) would be interested in reviewing the site for their perspective into the geology and interpretation portions; Gayle welcomed such assistance and will furnish the web link when it comes on-line.

The NHA has a very active role at Bryce Canyon, and it's nice to see that a geologist is heading this organization. When Gayle Pollock came to BRCA in October 1995, a major focus was to get universities more active in geological research for partnerships. The approach was to target senior level students and try to convince them to do MS or Ph.D. research at BRCA. Several students have been funded by the NHA since 1995. Gayle supplied meeting participants with informative folders pertaining to the status of research, geologic maps, and other useful material; he is to be thanked for putting these brochures together.

The NHA is responsible for distributing funds for park proposals from BRCA for research, whether geologic, biologic, or education/outreach (Debbie Cantu handles most of this as an NPS employee funded by the NHA). Bruce Heise mentioned also that funding for geologists-in-the-parks (GIP) and student conservation association (SCA) might also be available to assist the NHA.

UGA GUIDEBOOK ON UTAH'S NATIONAL AND STATE PARK AREAS

Grant Willis of the UGA announced that a guidebook treating the geology of 27 of Utah's national and state parks and monuments would be compiled for publication in September 2000. This compilation will be a snapshot into the geology of each park and covers most facets of what the GRI is trying to develop for each park for a final report (i.e. cross sections, simplified geologic map, general discussions of rocks, structure, unique aspects of park geology, classic viewing localities). The only NPS unit in Utah that will **not** be treated will be Golden Spike National Historic Site.

Funding for this publication is coming jointly from the UGA, NPS, BLM, USFS and Utah state parks; it is hoped that the publication will be sold for under \$30.

Each author will be *encouraged* to get with NPS staff interpreters to develop a product that aims at a wide audience (the common visitor, the technical audience and the teaching community). Bryce Canyon NP authors will be our field trip leader (George Davis, who has also tried to enlist the services of Gayle Pollock into the project).

Park authors are strongly encouraged to get with NPS staff to make sure that any trail logs do follow maintained trails and do not take visitors into unauthorized areas, or places where resources are fragile and would be disturbed by increased visitation (i.e. areas with cryptogamic soils).

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Also, a CD-ROM will be distributed with the publication featuring road and trail logs for specific parks as well as a photo glossary and gallery. The photo glossary will describe certain geologic features (i.e. *what is crossbedding?*). These will also be available as web-downloadable Adobe Acrobat PDF files. The UGA cannot copyright this material because it is funded with state money, so it can be distributed widely and freely, which will also benefit the purposes of the GRI. Additional reprints are not a problem because of the digital nature of the publication and the UGA board is committed to additional printings as needed. UGA normally prints 1000 copies of their publications because they become dated after about five years; that will probably not be an issue for this publication. Prices for the full-color guidebook are estimated to be approximately \$25/copy, and sales are expected to be high (exact estimates for Capitol Reef NP were 125 copies/year). A website for the guidebook is forthcoming in October 1999.

Field Trips will be held in September 2000. Currently, four field trips are scheduled:

1. Arches NP, Canyonlands NP, Dead Horse Point State Park (SP)
2. Antelope Island SP and Wasatch Mountain SP
3. Zion NP, Bryce Canyon NP, Snow Canyon SP and Quail Creek SP
4. Dinosaur NM, Flaming Gorge NRA, and Red Fleet SP

Note: Trips 1 and 2 will run concurrently and Trips 3 and 4 will also run concurrently.

Many other benefits are anticipated from this publication and are enumerated below:

- This type of project could serve as a model for other states to follow to bolster tourism and book sales promoting their state and its geologic features.
- Sandy Eldredge (UGS) will be targeting teaching communities for involvement in the field trips; hopefully teachers will pass on what they have learned to their young audience.
- The language is intended to appeal to someone with a moderate background in geology and yet will be very informative to the educated geologist.
- The publication may be able to serve as a textbook to colleges teaching Geology of National Parks (in Utah).
- A welcomed by-product could be roadlogs between parks in Utah for those visiting multiple parks, perhaps with a regional synthesis summarizing how the overall picture of Utah geology has developed.

NATURAL RESOURCES

Doug Neighbor (BRCA) is working closely with Llyn Doremus (Waterworks Consultants) on various water issues surrounding the Bryce watershed. He may also wish to consult

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with Dean Tucker (NPS-WRD) for additional assistance. Doug also mentioned that both the NPS-WRD and USGS-WRD are doing research in southwestern Utah for water rights.

Llyn told the group that her project involves water sampling for chemistry and streamflow measurements to model and prepare a hydrologic budget for the park. She believes general groundwater flow to be northward. Alluvial sediments supply water for the park. Also, it seems that the volcanic rocks associated with the Marysville Complex are contributing iron to the water chemistry at various springs within the Claron Formation. The Straight Cliffs seem to act as a sink for groundwater, and structures are contributing to discharge at Mossy Cave. Infiltration, rather than run-off seem to be the general rule for the Claron; specific conductivity of 150 feet per day has been observed.

Gayle Pollock is interested in having a Paleontological Survey conducted for BRCA. Similar studies have been done at Zion, Yellowstone and Death Valley. Vince Santucci (NPS-GRD Paleontologist) needs to be contacted for his input on this matter. Gayle mentioned that Bill Cobban (USGS) also has done extensive work on the marine fauna of the region, and that currently a student from Northern Illinois University is searching for vertebrates in the area.

Similar surveys have been done for Yellowstone and Death Valley NP's and have shed valuable new information on previously unrecognized resources. These surveys involve a literature review/bibliography and recognition of type specimens, species lists, and maps (which are unpublished to protect locality information), and also make park specific recommendations for protecting and preserving the resources.

The Death Valley Survey will be available soon. The **Yellowstone** Survey is already available on-line at:

http://www.nature.nps.gov/grd/geology/paleo/yell_survey/index.htm

and is also available as a downloadable PDF at

<http://www.nature.nps.gov/grd/geology/paleo/yell.pdf>

If a paleontological survey yields significant findings, paleontological resource management plans should be produced for Bryce Canyon involving some inventory and monitoring to identify human and natural threats to these resources. Perhaps someone on the park staff could be assigned to coordinate paleontological resource management and incorporate any findings or suggestions into the parks general management plan (GMP). It would be useful to train park staff (including interpreters and law enforcement) in resource protection, as the fossil trade "black market" has become quite lucrative for sellers and often results in illegal collecting from federal lands.

Collections taken from this area that now reside in outside repositories should be tracked down for inventory purposes. Fossils offer many interpretive themes and

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combine a geology/biology link and should be utilized as much as possible in interpretive programs.

COOPERATIVE GEOLOGIC MAPPING EFFORTS FOR BRYCE CANYON NP ***UGS Perspective***

Currently, the UGS is mapping in Utah at three different scales:

- **1:24,000** for high priority areas (i.e. National and State parks)
- **1:100,000** for the rest of the state
- **1:500,000** for a compiled state geologic map

The availability of funding for Cedar Breaks and Zion (jointly with the NPS) has made it possible for these higher priority areas to be mapped at **1:24,000** detail. The UGS plans to complete mapping for the entire state of Utah within 10-15 years at **1:100,000** scale. For **1:100,000** scale maps, their goal is to produce *both* paper and digital maps; for **1:24,000** scale maps, the only digital products will be from "special interest" areas (i.e. areas such as Zion and growing metropolitan St. George). Grant Willis mentioned that the UGS simply does not have enough manpower and resources to do more areas at this scale. He also reiterated that UGS mapping goals are coincident with those of the National Geologic Mapping Program.

In the Zion and Cedar Breaks areas, the UGS has been jointly cooperating with the NPS and USGS for some time on producing these **1:24,000** quadrangles in both paper and digital format. Until 1995, the USGS had done major mapping projects under the BARCO (Basin and Range to Colorado Plateau transition project) mapping program. When the USGS reorganized, many of these projects were put on indefinite hold. Fortunately, there has been mutual cooperation between the UGS and USGS to work together to get these products completed for the NPS. The NPS appreciates the labor of all involved parties and individuals in this cooperative and hopes that many products will result from the combined efforts of all involved agencies.

Because of the adequate coverage for the Bryce Canyon area, the UGS considers this a lower priority area at this time.

USGS Perspective

Pete Rowley (USGS) talked about the immense scope of the BARCO project for preparing **1:100,000** scale maps for earthquake potential, mineral resources and various other themes. Mapping was done at **1:24,000** scale and compiled at **1:100,000** scale. Unfortunately, this project was put on the backshelf because of the USGS 1995 reorganization and many of the original workers have not been able to realize final products for their previous mapping efforts.

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Since the USGS now requires digital geologic maps for all of their work, Pete is working with Southern Utah University's (SUU) Dave Maxwell to complete digitizing for some of the BARCO work.

There are many 7.5-minute quadrangles in the BRCA, ZION, and CEBR areas that are in various stages of completion from USGS personnel; Pete Rowley hopes that he will be able to help tidy up some of these unfinished maps and make them ready for publication.

Current Status

Several 7.5-minute quadrangles cover Bryce Canyon NP:

- Tropic Canyon
- Bryce Canyon
- Tropic Reservoir
- Bryce Point
- Cannonville
- Podunk Creek
- Rainbow Point

(see [*Appendix C, Bryce Canyon NP Index of Geologic Maps, 1:24,000 Scale*](#)).

These quadrangles have been compiled into the "**Geologic Map of Bryce Canyon National Park and Vicinity, Southwestern Utah**" by William E. Bowers, USGS Map I-2108, 1990. This map is 1:24,000 scale, and contains an accompanying pamphlet summarizing the stratigraphy and structure of the area. It is sold in the Bryce Canyon Visitor Center for \$3.95. It is not yet available in a digital format.

Bowers map was peer reviewed by Pete Rowley, who thinks it is an excellent map. Bowers has since passed on, and Rowley is attempting to locate the greenlines for digitization; he will keep the NPS posted on what he finds out.

There was general consensus that this map is adequate for digitization at the present time. In the future, with funding and manpower, the following exceptions/enhancements were proposed:

- George Davis mentioned that he thought some structural enhancements could be made including more definitive information on faults and folds, and perhaps cross sections showing more detail for the Ruby's Inn and Pine Hill thrust faults.
- Gayle Pollock is remapping the **Tropic Canyon 7.5'** quadrangle because Bowers did not differentiate the various members of the *Cretaceous Straight Cliffs Formation*; Gayle would like to show the main coal zones. The Straight Cliffs members do not need to be broken out in other areas of the park because not much is exposed, and what is gets covered by mass wasting. He is also putting a major emphasis on the Quaternary geology with landslides and hazards on this quadrangle.

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- Grant Willis would like to make sure that the Quaternary geology is represented as best as possible; Gayle and Pete Rowley thought that overall, the Quaternary was treated sufficiently by Bowers. Grant thinks the rest of the map is quite good also, and proposes a geologic hazards layer.
- Gayle Pollock has a few issues with the orientation of the Paunsaugunt Fault around Little Henderson Canyon that he would like to resolve.
- There was also discussion on how to include the Red Canyon corridor into the "area of interest" for Bryce Canyon NP. Red Canyon would include the north end of the Wilson Peak and the Casto Canyon quadrangles, and would be approximately six square miles. It was mentioned that maybe John Anderson has mapped here already, or George Davis may be able to get some students to map the area for inclusion in the BRCA digital map.
- Gayle Pollock also thought that additional quadrangles to the north that show thrusting in the Claron Formation are of great interest to BRCA, as well as the volcanic story of the Marysvale Complex. However, these would be more likely useful for the viewshed. Pete Rowley has done extensive mapping in the northern reaches at 1:62,500 scale but has published only a few pieces

Pete Rowley also mentioned that the USGS has agreed to fund the digitization of the **Kanab** (to the south of Bryce Canyon; see Appendix D, UGS 1:100,000 Quadrangles for entire state of Utah) 1:100,000 quadrangle through SUU, and Pete hopes to begin overseeing this project in the very near future. Kanab greenlines are also available.

The **Panguitch** (encompassing the Bryce Canyon area) 100,000 quadrangle is also being digitized by Florian Maldonado (USGS-Denver) in his spare time. Grant Willis is hoping Pete and Florian will be able to complete this at some point so that this area will be covered thoroughly.

Pete also mentioned that Richard Hereford (USGS) has mapped the area at 1:100,000 scale and is a Quaternary geologist, should he need consulted.

There are some issues to consider in completing digitization of these quadrangles:

- Pete would need some financial assistance in digitizing these maps at SUU. Dave Maxwell is willing and able to get a GIS shop going on NPS and BARCO projects as he has sufficient equipment and personnel. With Pete's oversight and input, it is hoped that many products may result from the SUU GIS department. Dave Maxwell would also like to get with the UGS for his input on how to scope out these digital geology projects.

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- Pete's salary and time needs to be covered by the USGS to oversee digitization work on this project, as well as potential field mapping projects around Cedar Breaks NM.
- A priority list for quadrangles of interest should be developed for SUU and estimates of costs and time to complete the work also need to be ascertained. Grant Willis suggested that a few weeks for a single quadrangle seems like a reasonable amount of time.

OTHER SOURCES OF NATURAL RESOURCES DATA FOR BRYCE CANYON NP

- The UGS has a significant quadrangle database that they have furnished to NRID for the entire state of Utah.
- NRID has compiled a geologic bibliography for numerous parks and monuments, including Bryce Canyon. Visit the website at: <http://165.83.36.151/biblios/geobib.nsf>; **user id** is "geobib read", **password** is "anybody".
- Bill Bowers Geologic Map for Bryce Canyon available in the visitor center
- The "***Shadows of Time: The Geologic Story of Bryce Canyon National Park***" by Frank DeCourten is an excellent summary for the layperson and geologist alike; it is available from the visitor center for \$9.95
- The USGS has compiled large volumes of data on the BARCO project that was halted in 1995; much of this work is unpublished and should be sought out from USGS personnel.
- Doug Neighbor was asked if BRCA currently has their ProCite software in place that chronicle any natural resources into a bibliography. Doug says he installed it two years ago.
- George Davis mentioned that in September 1999, he will have a GSA Special Paper on the "*Structural Geology of the Southern Utah part of the Colorado Plateau with Special Emphasis on Deformation Bands*". This will detail major geologic structures of the southern Utah parks and monuments East-West from the Henry Mountains to Zion NP, and North-South from the San Rafael Swell to the Arizona state line. Much of the paper will be devoted to deformation band shear zones in the Entrada and Navajo sandstone, and plate tectonic descriptions for the Mesozoic and Cenozoic.
- George also mentioned a paper on basement cored uplifts featuring the East Kaibab Monocline and Colorado Plateau, featuring detailed cross sections. This will be separate from the GSA Special Paper.

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- Llyn Doremus will be publishing a water resources report for Bryce Canyon NP sometime in the near future; Pete Rowley would like a copy of this report to review since he's been doing similar work at the Nevada test site, GRD would also like a copy.

GEOLOGIC HAZARDS

- The main geologic hazard discussed for BRCA involves mass wasting and rock falls along the most traveled walking trail in the park: the **Navajo Loop trail**
- Trail stabilization receives much attention because of the potential for injuries and such
- Siting facilities is also a major issue because of the fractures and potential for sloughing; these areas should be monitored for growth and potential danger.
- Seismic/active faults in close proximity to BRCA area
- Volcanics (Marysvale volcanics)
- Visitor center not setting on bedrock; it's at 28 feet so caissons needed
- Highway 12 dump
- Mudslides in Cretaceous units in back country causing mass wasting in Yellow Creek, but less visitation in these areas
- Doug mentioned a cave that was dynamited shut in the 1970s because it had vertical openings that posed a safety hazard.

POTENTIAL RESEARCH TOPICS FOR BRYCE CANYON NP

A list of potential research topics includes studies of the following:

- Study the progressive evolution of hoodoos; examine morphology and internal stratigraphy and structure for interpretive value
- Study the role of enlarging fractures through solution weathering and freeze-thaw cycles
- Study the role of jointing versus faulting (both strike-slip and thrust faulting)
- Study how different lithologies respond to weathering and erosion
- Study rates of edge migration, erosion, retreat of rim, rates of downcutting of streams at the canyon bottom, aggradation of fill at bottom, slumping in the Tropic Shale (i.e. all of which are processes affecting landscape evolution)

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- Use diffusion modeling to help map drainage patterns (University of Arizona has Geomorphologist who does this)
 - Study the structural controls on the course of the Paria River that direct it towards Bryce Canyon
 - Study effects of fluid-rock interactions and results
 - What is the effect of the syncline on hoodoos
 - Study hoodoo fluting to see if it's vertical or affected by bedding
 - Determine extent of Cretaceous thrust above the amphitheater to the south
 - Study the Markagunt Megabreccia near Cedar Breaks for regional implications
 - Determine the age and provenance of the Boat Mesa Conglomerate; is it Oligocene or Pliocene, and if the Brian Head and Boat Mesa correlate to each other.
 - Determine how much volcanic material was originally in the park and subsequently removed by erosion
 - Study the Cretaceous rocks to determine if dinosaurs are present in the backcountry; currently have student from Northern Illinois looking for remains on Markagunt and Paunsaugunt areas
 - Permeability and quantity of water assessment for entire Bryce Canyon NP
 - Examine the potential for a K-T boundary in the Table Cliffs area and its relation to the Kaiparowits Formation
-

DISTURBED LANDS

Doug says a disturbed lands inventory was conducted at BRCA, but nothing significant was found. No coalmines are within the park boundary either because it is too difficult to extract. There are a few bentonite quarries on Highway 12 in the upper part of the Tropic Shale.

UNIQUE GEOLOGIC FEATURES

- Natural Bridge
 - Boat Mesa (all conglomerate)
 - Sinking Ship
 - Inverted hoodoo (klippe); but hard to get visitors there (we visited it during field trip)
 - Mossy Cave (more of an overhang from discharge); could be a nice hanging garden with ice stalactites and stalagmites; only flat trail alongside a stream
 - Paunsaugunt fault
 - Sevier fault at Red Canyon
 - Bryce Point and Boat Mesa normal faults (on Bowers map and Shadows of Time book)
 - Thor's hammer from Sunset Point; has dolomite capstone
-

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ACTION ITEMS

Many follow-up items were discussed during the course of the scoping session and are reiterated by category for quick reference.

Interpretation

- If desired NHA consult with GRD's Jim Wood (jim.f.wood@nps.gov), UGS Sandy Eldredge(nrugs.seldredge@state.ut.us) or Melanie Moreno at the USGS-Menlo Park, CA (mmoreno@usgs.gov) for additional assistance with various interpretation themes
- Gayle Pollock supply web address for expanded web page for BRCA NHA with GeoDetective site

UGA Guidebook

- Attempt to plant the seeds of this concept to other states for similar publications involving local area geology. Such publications are especially useful for the GRI

Natural Resources

- Llyn Doremus supply to interested parties her report on Water Resources for BRCA; including copies to Pete Rowley and GRD.
- Consult with Vince Santucci on the likelihood of a full paleontological survey for BRCA (only the marine has been studied thus far; may yield significant vertebrates)

Geologic Mapping

- Attempt to locate Bill Bowers greenlines to digitize from (Pete Rowley is working on this)
- USGS address issues relating to funding salaries and other work to ensure BARCO products can be published
- NPS and USGS develop for SUU a priority list of quadrangles to digitize from existing Bowers 1990 map, as well as associated estimates of time and material costs

Natural Resource Data Sources

Miscellaneous

- Review proposed research topics for future studies within Bryce Canyon NP
- NPS GRD folks make contact with USGS GIS person Jeremy Workman to develop relationship with NPS GIS projects
- Have conference call with Gregson, Heise, Connors, Rowley and Maxwell to discuss potential future projects, including possible digitization of the BRCA maps of Bill Bowers (1990)
- Doug Neighbor needs an upgrade from his existing version of ArcView

APPENDIX A

Bryce Canyon NP Geological Resources Inventory Workshop Participants *July 13-14, 1999*

NAME	AFFILIATION	PHONE	E-MAIL	Field Trip	Scoping Session
Bruce Heise	NPS, Geologic Resources Division	(303) 969-2017	Bruce_Heise@nps.gov	x	x
Steve Fryer	NPS, Natural Resources Information Division	(970) 225-3567	Steve_Fryer@nps.gov	x	x
Tim Connors	NPS, Geologic Resources Division	(303) 969-2093	Tim_Connors@nps.gov	x	x
Pete Rowley	USGS	(435) 865-5928	prowley@usgs.gov	x	x
Gayle Pollock	BRCA Natural History Association	(435) 834-4413	Gayle_Pollock@nps.gov	x	x
Grant Willis	Utah Geological Survey	(801) 537-3355	nrugs.gwillis@state.ut.us	x	x
Doug Neighbor	BRCA	(435) 834-4901	Doug_Neighbor@nps.gov	x	x
George Davis	University of Arizona	(520) 621-8447	Gdavis@geo.arizona.edu	x	x
Danielle Rousseau	NPS, Geologic Resources Division	(303) 987-6925	Danielle_Rousseau@nps.gov	x	x
Debbie Cantu	BRCA Natural History Association	(435) 834-4413	Debbie_Cantu@nps.gov	x	x
Bill Case	Utah Geological Survey	(801) 537-3340	Nrugs.bccase@state.ut.us	x	
Llyn Doremus	Waterworks Consultants	(206) 244-8640	Ladoremus@aol.com	x	x

APPENDIX B

Overview of Geologic Resources Inventory

The NPS Geologic Inventory is a collaborative effort of the NPS Geologic Resources Division (GRD) and Inventory and Monitoring Program (I&M) with assistance from the U.S. Geological Survey (USGS), American Association of State Geologists (AASG), and numerous individual volunteers and cooperators at NPS units, colleges, and universities.

From the perspective of the servicewide I&M Program, the primary focus (Level 1) of the geological inventory is

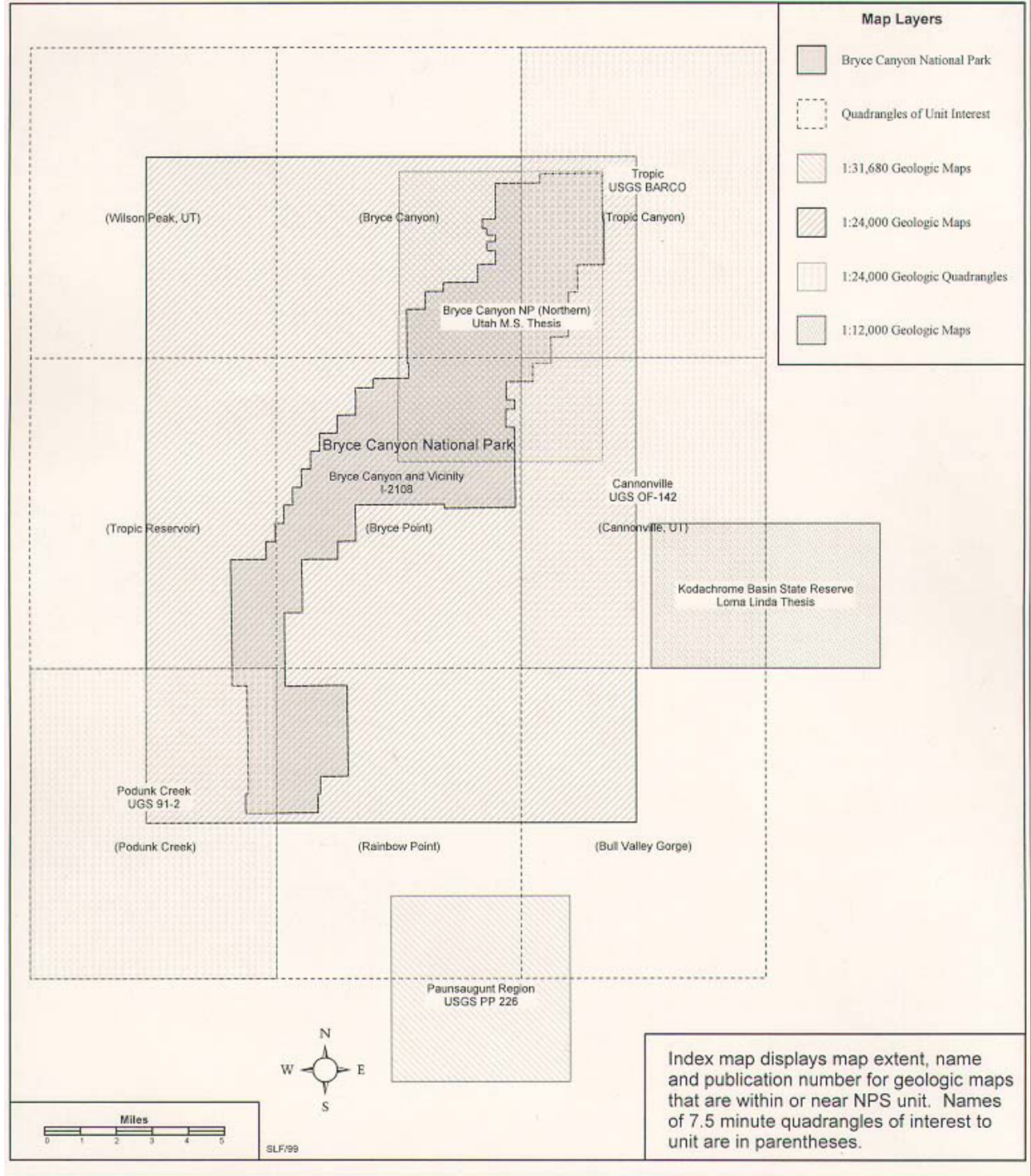
1. to assemble a bibliography of associated geological resources for NPS units with significant natural resources,
2. to compile and evaluate a list of existing geologic maps for each unit,
3. to develop digital geologic map products, and
4. to complete a geological report that synthesizes much of the existing geologic knowledge about each park. The emphasis of the inventory is not to routinely initiate new geologic mapping projects, but to aggregate existing information and identify where serious geologic data needs and issues exist in the National Park System.

The NPS Geologic Resources Division is an active participant in the I&M Program and has provided guidance and funding in the development of inventory goals and activities. GRD administers the Abandoned Mine Lands (AML) and Geologists In Parks (GIP) programs which contribute to the inventory. NPS paleontologists, geologists, and other natural resource professionals also contribute to inventory planning and data. A major goal of the collaborative effort is to provide a broad baseline of geologic data and scientific support to assist park managers with earth resource issues that may arise.

For each NPS unit, a cooperative group of geologists and NPS personnel (the Park Team) will be assembled to advise and assist with the inventory. Park Teams will meet at the each NPS unit to discuss and scope the geologic resources and inventory, which is the subject of this report. If needed, a second meeting will be held at a central office to evaluate available geologic maps for digital production. After the two meetings, digital geologic map products and a geologic report will be produced. The report will summarize the geologic inventory activities and basic geology topics for each park unit. Due to the variety of geologic settings throughout the NPS, each report will vary in subject matter covered, and section topics will be adapted as needed to describe the geologic resources of each unit. Whenever possible the scientific sections of the report will be written by knowledgeable cooperators and peer reviewed for accuracy and validity.

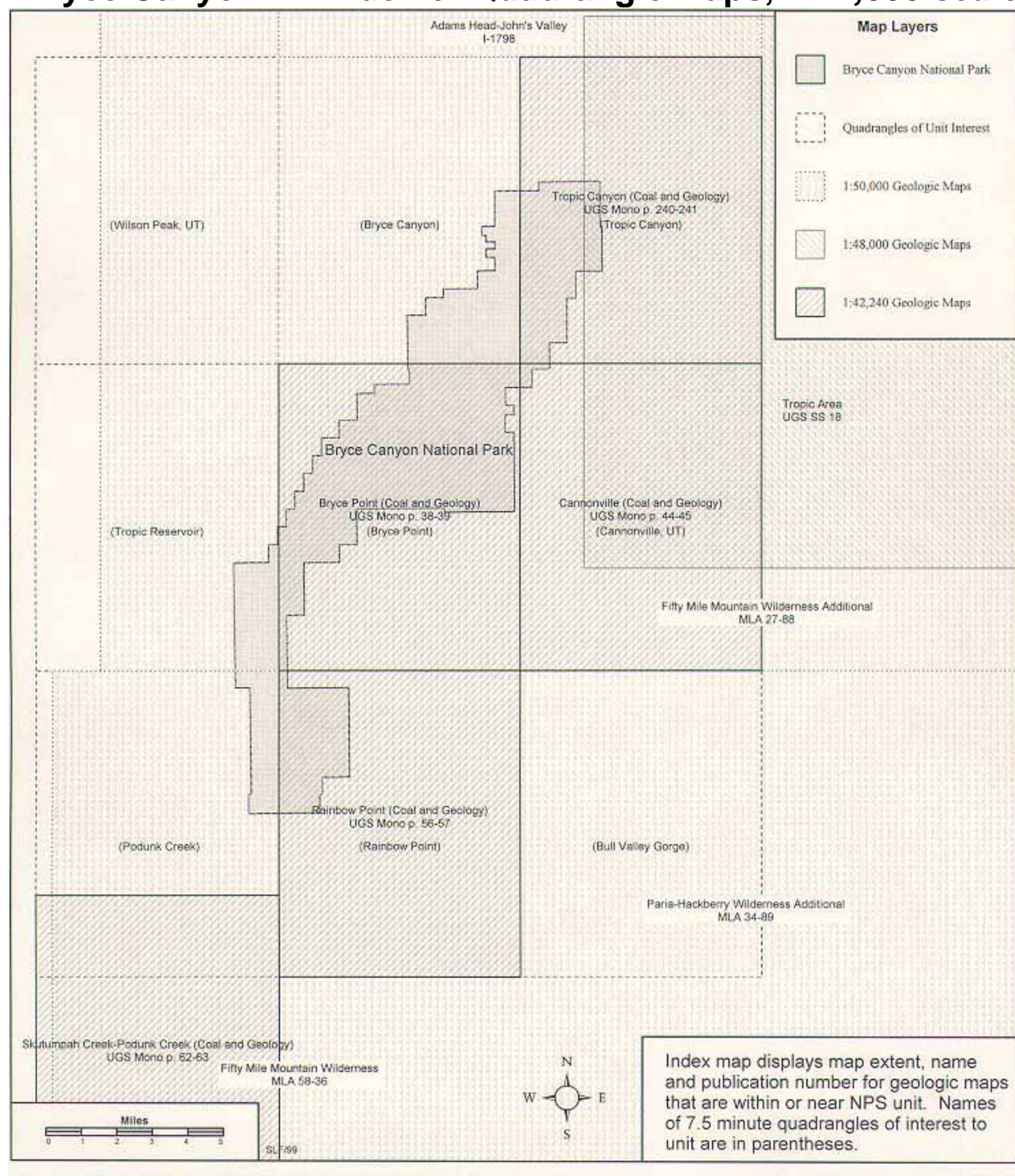
APPENDIX C

Bryce Canyon NP Index of Quadrangle Maps, 1:24,000 scale



APPENDIX C

Bryce Canyon NP Index of Quadrangle Maps, 1:24,000 scale



APPENDIX D

UGS Index of Quadrangle Maps, 1:100,000 scale

